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Document Version

Publisher's PDF, also known as Version of record

Publication date:

2016

[Link to publication in University of Groningen/UMCG research database](#)

Citation for published version (APA):

Nunes da Silva, T. J. (2016). *Approaching conformality in non-Abelian gauge theories*. [Thesis fully internal (DIV), University of Groningen]. University of Groningen.

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Approaching Conformality in non-Abelian Gauge Theories

Tiago José Nunes da Silva, 26 februari 2016

1. The exotic phase observed in the $SU(3)$ theory with twelve fundamental (staggered) fermions on the lattice is a result of the competition between local terms and next-to-nearest neighbour interactions introduced by improvement of the fermion action. This is a general feature of improvement which appears as a lattice artefact in the gauge theories of interest in this thesis, but it can also appear as a physical phase in materials such as graphene.
2. The combined evidence indicate that the rapid variation of the chiral condensate observed in the $SU(3)$ theory with twelve fundamental flavours at strong coupling is not to be associated to a finite temperature phase transition as in QCD, but rather indicates a first order zero-temperature phase transition proper of the conformal window.
3. The $SU(3)$ lattice system with twelve fundamental flavours exhibits restored chiral symmetry and retains signatures of the underlying conformal symmetry of the fixed point.
4. The small value of the fermion mass anomalous dimension for the $SU(3)$ theory with twelve fundamental flavours suggests a change of paradigm: this theory is not located close to the lower edge of the conformal window, as it was previously believed, but significantly above it.
5. The results presented in Chapter 3 point at a lower edge of the conformal window for $SU(3)$ gauge theories with fermions in the fundamental representation below eight flavours and close to seven, in agreement with perturbation theory calculations and large- N arguments.
6. The perturbative results presented in Chapter 3 on the anomalous dimension of the scalar glueball operator beg for a nonperturbative confirmation, given their theoretical and phenomenological implications.
7. From the phenomenological point of view, the results presented in this thesis make $SU(3)$ gauge theories with fermions in the fundamental representation more attractive, since conformality can be achieved for a considerably lower number of flavours than what was initially believed.
8. The efforts and computational resources dedicated by researchers in lattice field theory into understanding the phase diagram of gauge theories have provided us not only with a greater understanding of this vast subject, building an important framework for models of Physics beyond the Standard Model, but it has also equipped lattice theorists with the computational tools, algorithmic strategies and the experience to tackle many new problems in field theory.
9. Brazilian politics and economics are as conceptually wrong as the Dutch notion of a proper lunch.
10. B I.II.III RUG REC AS BN CO DW / QCDW DPCX ISDQ HIMD PVR Y CPIH JOIX MNJH JSAS QPBI TQNL YTZF OZGV ZORH NFWI WTCG ZMXO PKOM ZVTI YDQY NTSJ XQXE M
(see section three of <http://enigma.louisedade.co.uk/help.html>)